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CULTIVATION AND APPLICATION OF COPEPOD AND CLADOCERAN FOR LARVAL REARING IN JAPAN: PAST, PRESENT AND FUTURE

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Zooplankton as live food for marine finfish larviculture are still important in aquaculture. Although *Artemia* nauplii had been introduced as live food since the1940s, it was already known that their nutrition, especially DHA-EPA contents, was so poor for larval fishes to culture. And *Artemia* nauplii were too large (400 μm -) to apply to larval fishes of some species just after hatch. In order to search the smaller size and more abundant nutrition of live food, various species of zooplankton used to be attempted in marine larval rearing worldwide, also in Japan. Many species of zooplankton were collected from natural seawaters, and then fed on larval fishes directly in hatcheries. Although their nutritional value for larval fishes was abundant, it was difficult to culture most of them. The harvested quantities from natural seawaters fluctuated and the supplies for larvae, therefore, were unstable. It was possible to culture some species of copepod and cladoceran in the open pond. Those cultures were also unstable, and they needed the large area, such as an open pond, and a great deal of labor to maintain them.

Euryhaline rotifer *Brachionus* was introduced as first live food for larval fishes in the 1960s in Japan. Rotifer was easier and more stable to be cultured and many hatcheries began to use it as live food. In the 1990s, most hatcheries of the world were using rotifer and *Artemia* as live food for larval fishes, and copepod and cladoceran seldom got used. Moreover, micro artificial diet for larval fishes were developed and the feeding system mainly performed in present, rotifer-*Artemia*-micro artificial diet, was established. In Japan, many studies of feeding or culturing of copepod and cladoceran used to be performed but not so many in present. Little hatcheries in Japan are feeding copepods collected from wild to larval fishes, but many avoid it to prevent fishes from the risk, such as disease including VNN. Therefore most hatcheries are according to the feeding system, rotifer-*Artemia*-artificial diet.

Recently, *Artemia* eggs have got difficult to be supplied stably and they have got more expensive. Copepod and cladoceran are expected as the replacement live feed of *Artemia*. Frozen copepod gets distributed commercially and used as the supplemental feed during fed on *Artemia*. Although the use of frozen copepod is getting to spread, it is still expensive and its quality is various by products. Moreover, some problems, e.g. skeletal deformity and malpigmentation, have been still insoluble with the feeding

system, rotifer- *Artemia*- artificial diet, or the improvement of the nutrition contents of the present feeding system. Some studies got rid of the malpigmentation by feeding on copepod, and some reported the success of the cultivation of small mouth larval fish such as grouper larvae by feeding on the nauplii of copepod In each study, copepod was collected from open seawater, or cultured in the open pond. In order to supply copepod and cladoceran stably with good quality to larval fishes, it is necessary to develop in-door intensive culture technology.

The followings are important to develop the intensive culture of copepod and cladoceran and to supply them stably: 1) screening the species of micro algae and concentration of the culture, 2) how to maintain the culture water quality and 3) mass production of their resting eggs for storage.

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Developmental Stage and Morphogenesis of Finfish Larvae, with special reference to Improvement of Larval Health

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Introduction

To a greater or less, there are deformities in hatchery-raised juveniles. It is the key factor for survival in the field after release and for stocking effectiveness. It is also key issue of severe mortality and low market price in aquaculture industry. Fish quality, or ecological robustness, is defined as the ability to adapt to natural conditions at release site. The objective of the production of the hatchery-raised seed is to supply high quality seeds for stock enhancement and aquaculture. One of the main causes of deformity should be some nutritional condition of live feed, such as Vitamin A, D, and DHA concentration. We are now conducting the research and development on determination of suitable nutritional condition of live food, such as rotifer and *Artemia*, for finfish larviculture.

Materials and methods

In first, we conducted the experimental larviculture of *Paralichtys olivaceus*, *Inimicus*